ROBOTS IN FILM AND ADVERTISING INDUSTRY

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Abstract: *This seminar paper discusses the possibilities of using robots for operating cameras in the film and advertising industry. It offers a brief history and looks at the current state as well as at the most well-known companies that develop such robots.*

Keywords: *camera robot, cinematography, history of film, film industry, advertising industry*

1 Introduction

Due to increasingly challenging scenes in movies, filmmakers had started to employ robots alongside the usual human-operated camera crew. The main advantage robotic systems have is their ability to keep the camera they are operating steady. They can also reach higher speeds when compared to a human, have a higher level of precision, and make it possible to shoot complex camera trajectories repeatedly. [12]

Author's note: The advantage of camera robots over a usual camera crew is demonstrated better in video recording than still photography.

2 In movie industry

The first use of robots in the movie industry for camera operation reaches as far as *2001: Space Odyssey (Stanley Kubrick, 1968)* and *Star Wars: The New Hope (George Lucas, 1977)*, but at that time the robots were always custom-built and required a highly-specialized operator [14]. In the 1980s, filmmakers started to rely on a new, fast-spreading trend – computer-generated imagery (CGI). It took more than two decades before major movie productions turned back to practical effects and employed robots again. This time they used industrial robots, which were easily accessible, but their software had to be adjusted so that it could be controlled by non-robotic experts, such as animators. [9]

Since then, many movies, i. e. *Moulin Rouge (Baz Luhrmann, 2001), Hugo (Martin Scorsese, 2011)*, had utilized robots in various scenes. This had allowed filmmakers to exceed the limits of a human crew. Takes shot by robot-operated cameras are precise and smooth without any camera shake. Some visual effects had become easier to shoot – for example, objects can appear or disappear in a frame by pausing, removing the object while the camera is held perfectly steady, then resuming the scene. Similarly, filmmakers can achieve optical illusion where the trick is based on a specific point of view. As shown in Figure 1, this can be noted in *Inception (Christopher Nolan, 2010)*. The actors are walking on a seemingly endless Penrose staircase, but the moment the camera shifts, the optical illusion is broken [21]. Robot arms can also help shoot action sequences, such as the one in *Fistful of Vengeance (Roel Reiné, 2022)*. [18] When combining the use of robots with a green screen, the resulting images can be seamlessly merged in post-production thanks to CGI. [12]

Figure 1: Optical illusion in *Inception (Christopher Nolan, 2010)* [15]

The first blockbuster movie that heavily relied on robots was *Gravity (Alfonso Cuarón, starring Sandra Bullock and George Clooney, 2013).* The majority of the events in the film takes place in zero gravity, with the actors spinning uncontrollably from time to time when an explosion occurs. The traditional way of shooting such scenes would be challenging, if not downright impossible, especially when considering Cuarón's style of shooting (continuous, extended takes). [9, 22] The movie production began over four years prior to its release. The hired company, Bot&Dolly, had to create a new control system for their robots – which took a year and a half – and then program the robots' movements in each specific scene. The system also had to contain multiple checks and safeguards because not only did the robots move cameras and equipment, they also carried the actors (see Fig. 2). [13, 22]

Figure 2: Making of *Gravity (Alfonso Cuarón, 2013)* [11]

Nowadays there are companies, such as MRMC or The Marmelade, that make robots specifically for cinematographers. Such companies and their specific products will be discussed later in this paper.

3 In advertising industry

In advertising, robots are an invaluable tool when it comes to shooting commercials that require quick and precise camera movement. This especially proves useful when promoting food, drinks, paint, sports equipment, or when working with explosives. Since each commercial focuses on a different product and requirements made by the companies vary a lot, the filmmakers have to be innovative with the use of robots and other equipment.

One of the representatives in this field is Steve Giralt, co-founder of a visual innovation production company "The garage" based in New York City. In their shoots, he and his team use multiple robots. One of them, usually Bolt or Milo by MRMC, is operating a camera while the others handle the promoted objects or other equipment. The camera used in these shoots is a Phantom VO 4K slow-motion camera that can shoot at a thousand frames a second. Such cameras are most often used when shooting scenes where liquid, fast-moving, or falling objects are involved. The other robots perform various tasks - be it dropping ice cubes or pieces of fruit, or pouring drinks. Those robots are usually custom-built. Every movement has to be perfectly coordinated which is why robots are used instead of humans. The use of robots also makes it possible to shoot the scenes multiple times with the same parameters. [16, 17] To illustrate, Figure 3 shows a burger commercial made by Giralt and his team. On the left is a behind-the-scenes photo of a robot that cuts through the rubber bands so the condiments fall. On the right is the resulting image. Some of the creative process and behind-the-scenes of various shoots is shared by Giralt on social media (*@stevegiralt* on Instagram).

Figure 3: Burger commercial [5]

Another example demonstrating the use of robotic rigs when shooting advertisements is a commercial spot for the Sherwin-Williams company. When promoting their new line of paints and primers, *Emerald*, the entire ad had been done using only said paint, a 1500-liter water tank, and a robotic system. Once again, the camera used was a Phantom slow-motion camera, this time mounted on a high-speed robot arm Spike developed by Marmelade which was partially submerged (see Fig 4, left). Other robotic systems had been tasked with releasing the paint, moving the water, and more. The resulting images had only undergone standard post-processing without any special effects involved (see Fig 4, right). [10]

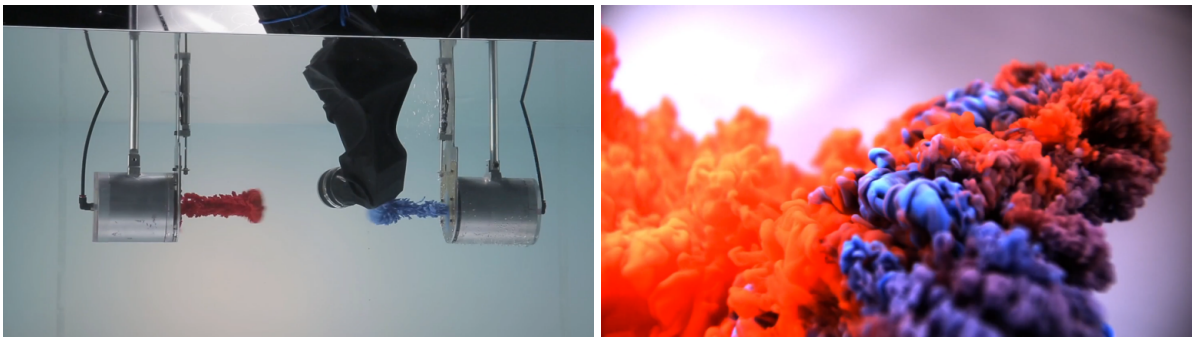

Figure 4: *Emerald*, paint and primer commercial for Sherwin-Williams company. [6]

All things considered, it is difficult to determine whether using robots in the marketing industry is monetarily beneficial, but it certainly offers new possibilities for teams of creators. Furthermore, since the shoots use the promoted merchandise instead of some substitutes, the finished commercial accurately depicts the advertised product.

4 Companies

Due to the rising demand for camera control robots, various companies specializing in these were established in the last two decades. In this section, we will refer to the most well-known ones.

Generally, the filmmakers can control six camera movements - dolly, pedestal, truck, pan, tilt and roll (see Fig. 5). The same terms are used when talking about the movements of camera robots so it corresponds with the terminology used by the standard camera crew. Other camera attributes the operator can control are focus, zoom and iris. [20]

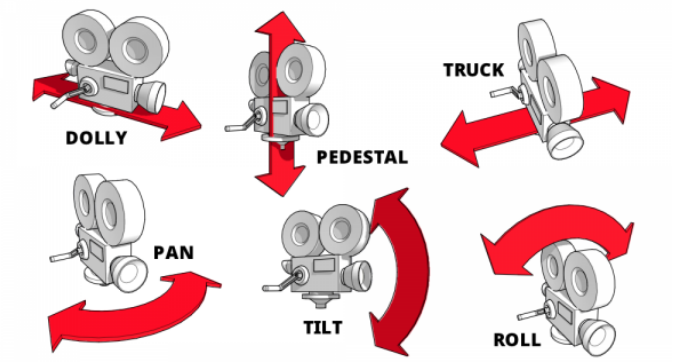

Figure 5: Camera movements [8]

4.1 Bot&Dolly

Bot&Dolly, established in San Francisco in 2009, is a design and engineering studio that specializes in the use of robotics in filmmaking. As previously mentioned in section 2, this studio took part in making *Gravity*. To accomplish this, they had used their motion control platform **IRIS**, which is a 7-axis robot with an attachable 3-axis head extension. A key limitation at that time was the software. To make camera robots accessible for filmmakers, Bot&Dolly created **BDMove**, a plugin for *Autodesk Maya*, which is a program used by animators and VFX crews worldwide. [19]

In the years following *Gravity*, the company had focused mainly on the use of their technology in art installations, until its acquisition by Google in 2013. Shortly after, the company disappeared from public view. Its website is inaccessible. [19]

Because of the company's evanescence, the revolutionary Autodesk plugin disappeared too. Multiple people had independently tried to recreate such tool, not having access to others' creations. To avoid this, Evan Atherton, engineer for *Autodesk Robotics Lab*, designed and released Mimic, a free open-source plugin for *Autodesk Maya* that essentially fulfills the role of BDMove. [1, 7]

4.2 MRMC

Mark Roberts Motion Control or MRMC based in the United Kingdom was established in 1966 by Mark Roberts. The company designs, manufactures and assembles a range of robotic camera control rigs. In 1999 it was awarded an Academy Award for its contribution to special effects in feature films. MRMC was acquired by Nikon Corporation in 2017. [3]

Cinematic robots or "cinebots" of the Bolt family (see Fig. 6) are utilized primarily when shooting high-speed motions. The basic **Bolt** robot's movement speed is up to 2 m/s, it can rotate 180° in 1 s and reaches up to 3.5 m. When requiring a longer reach, **Bolt X** is an option with its maximum reach of 4.3 m. On the other hand, when a smaller, more lightweight cinemabot is needed, one can choose **Bolt Jr+**. [3]

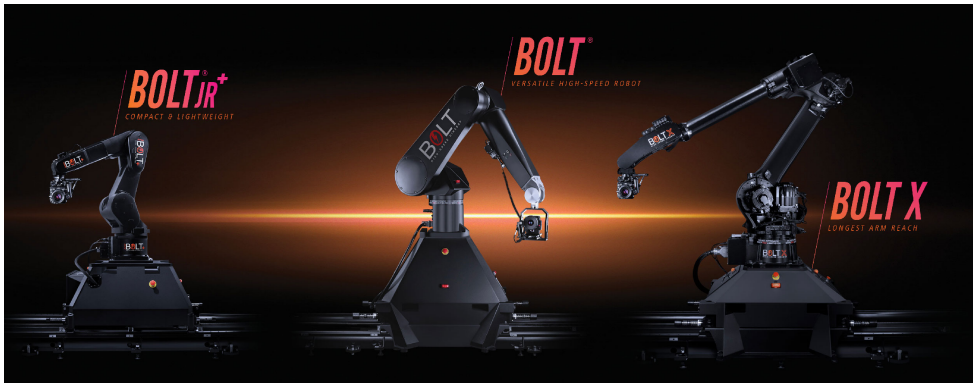

Figure 6: "Cinebots" of the Bolt family by MRMC [3]

Milo is advertised as ideal for filming on sets where the rig needs to be moved around. It can be transported whole or broken down into seven parts. What's more, a group of just three people can set the rig up within an hour. With its track speed of 2 m/s and maximum lens height of 4.1 m, it claims to be a great compromise between portability and high accuracy. [3]

All MRMC camera rigs use **Flair** software (currently version 7), which allows to export and import data to and from various graphics packages, such as *Maya* or *Motionbuilder*. The company claims it has an intuitive graphical user interface. [3] To create a motion of an MRMC robot, the user simply moves the camera to the desired position and stores it. Flair then creates a path between the entered positions while adjusting the camera's focus. In addition, the software adjusts all the axes so that the camera points at the recorded object. This action is called target tracking and was developed by MRMC in the 1980s. [20]

MRMC's portfolio consists not only of cinema robots but other accessories one might need when shooting a scene. One of these is the bearing rail which widens the range of the robot's vertical movement. It is supplied in varied length sections that are joined to reach the desired length. Movement in vertical and axial axes can be also broadened by rigs or cranes. The company also offers various model movers, which can too be controlled by Flair software. For such task, a Bolt Mini Model Mover can be used. Other model movers include variety of linear motors, platforms and turntables that can manipulate objects as large as a car. [3]

4.3 The Marmalade

The Marmalade is a company based in Germany, that creates audio-visual content, specializing in tabletop and commercial product presentation. Its entire production resides in two studios that house three stages, along with every other part of the creative process from concept to post-production, as this company is not just a developer of camera robots. [4, 23]

The integral part is **SPIKE**, its high-speed motion control system. Just as MRMC, Marmalade offers additional components, such as turn-tables or additional motors to control rotary or linear motion of other objects on set. The software used by the SPIKE system fundamentally operates just as MRMC's Flair. [4, 23]

The Marmalade's portfolio includes collaboration with companies such as Sherwin-Williams, previously mentioned in this paper, Tic Tac, Pepsi, Miele, Nivea and Braun. [4]

4.4 Motorized Precision

Based in Oregon, US, Motorized Precision has been designing cinema robots since 2015. It has four robot lines, **Colossus**, **Kira**, **Mia**, and **Vigo** (see Fig. 7), the latter not being a camera robot but a model mover with a gripper that can carry up to 10 kg. Colossus, as is evident from its name, is the largest of the company's robots. With its height of 3.7 m and a maximum reach of 3.1 m, it is comparable to Bolt by MRMC. Both Kira and Mia are smaller yet more lightweight and can be placed on up to a 50-meter track system. [2]

Figure 7: Cinema robots offered by Motorized Precision (left to right: *Colossus, Kira, Mia, Vigo)* [2]

5 Conclusion

This paper had offered a brief overview of the use of camera-wielding robots in movies and commercials. The general advantage of robots is their ability to achieve actions that are out of range of human abilities – they are more precise, their movements are steady and repeatable. Various companies, such as MRMC or Motorized Precision, focus on developing cinema robots, their accessories, and software. Their main goal is to provide tools to execute the technical part of the process (creating path, adjusting focus, etc.) while the "human part of the crew" concentrates on the creative aspect of a project.

As mentioned in section 2, utilizing robots does not necessarily make the production less expensive, but it offers new possibilities to creative teams. In the future, camera robots might be used more commonly. They might also be used in shooting scenes where moving vehicles are involved.

Camera robots will not likely find employment in any other industry but considering how significant part of human lives centers around television and other media, I personally don't think any other branch of application is necessary.

References

[1] Lessons learned by roboticists in the entertainment industry are filtering back into industry. `https://www.mimicformaya.com/`. Online; accessed 4 Mar 2022.

[2] Motorized Precision. `http://motorizedprecision.com/`. Online; accessed 5 Mar 2022.

[3] Mark Robert Motion Control. `https://www.mrmoco.com/`. Online; accessed 25 Feb 2022.

[4] The Marmalade. `https://www.themarmalade.com/`. Online; accessed 5 Mar 2022.

[5] How this perfect "Burger drop" shot was made completely without CGI. `https://www.boredpanda.com/slow-motion-burger-drop-machine-steve-giralt/?utm_source=google&utm_medium=organic&utm_campaign=organic`, Aug 2016. Online; accessed 25 Feb 2022.

[6] Behind the scenes on Sherwin-Williams "Emerald, Epiphany". `https://www.stashmedia.tv/scenes-sherwin-williams-emerald-epiphany/`, Apr 2017. Online; accessed 3 Mar 2022.

[7] Austin-Morgan, T. Lessons learned by roboticists in the entertainment industry are filtering back into industry. `https://web.archive.org/web/20200901022432/https://www.eurekamagazine.co.uk/design-engineering-features/technology/lessons-learned-by-roboticists-in-the-entertainment-industry-are-filtering-back-into-industry/199677/`, Jan 2019. Online; accessed 4 Mar 2022 via Wayback Machine.

[8] Baverly Boys Production team. Camera movements explained with examples. `https://beverlyboy.com/cinematography/camera-movements-explained-with-examples/`, Sar 2020. Online; accessed 4 Mar 2022.

[9] Byrne, C. How robots filmed hollywood's latest blockbuster, 'Gravity'. https://venturebeat.com/2013/10/07/robots-filmed-hollywoods-next-blockbuster, Oct 2013. Online; accessed 26 Feb 2022.

[10] Cade, D. This incredible ad was shot with a robot arm, paint, and water... no cgi. https://petapixel.com/2017/04/19/incredible-ad-shot-robot-arm-paint-water-no-cgi/, Apr 2017. Online; accessed 1 Mar 2022.

[11] Carrillo, J. Gravity, el sueño de un robot industrial. https://blog.rtve.es/genx/2013/11/gravity-el-sueno-de-un-robot-industrial.html, Nov 2013. Online; accessed 27 Feb 2022.

[12] Chesher, C. Robots and the moving camera in cinema, television and digital media. In *International Workshop on Cultural Robotics* (2015), Springer, pp. 98–106.

[13] Cohen, D. S. Alfonso Cuaron returns to the bigscreen after seven years with 'Gravity'. https://variety.com/2013/film/news/alfonso-cuaron-returns-to-the-bigscreen-after-seven-years-with-gravity-1200596518/, Oct 2013. Online; accessed 26 Feb 2022.

[14] Collings, A. Motion control: A brief history. https://www.deckhand.com/blog/motion-control-a-brief-history, Feb 2018. Online; accessed 26 Feb 2022.

[15] Deab, J. Inception's endless staircase. https://www.moillusions.com/inceptions-endless-staircase/, Oct 2010. Online; accessed 4 Mar 2022.

[16] Edwards, P. How robots made this food commercial look effortless. https://www.vox.com/21515004/robot-commercial-film, Oct 2020. Online; accessed 25 Feb 2022.

[17] Genuth, I. Steve Giralt: Shooting commercials with robots. https://lensvid.com/gear/steve-giralt-shooting-commercials-with-robots/, Jun 2019. Online; accessed 25 Feb 2022.

[18] King, J. 'Fistful of Vengeance' video shows the cast using a high speed robotic Bolt camera to film a fight scene. https://collider.com/fistful-of-vengeance-fight-choreography-robotic-bolt-camera-behind-the-scenes/, Feb 2022. Online; accessed 5 Mar 2022.

[19] Maher, M. The awesome robots behind the camera. https://www.premiumbeat.com/blog/the-awesome-robots-behind-the-camera/, Sep 2015. Online; accessed 4 Mar 2022.

[20] Mark Robert Motion Control Ltd. Flair 7 Demonstration Video. https://www.youtube.com/watch?v=1pUrC9pyY9A, Sep 2019. Online; accessed 4 Mar 2022.

[21] Media Division. Motion Control – Filmmaking with optical illusions & layers of time – Epic Episode #12. https://www.youtube.com/watch?v=Vq9zivPEeQU&t=802s/, Feb 2020. Online; accessed 4 Mar 2022.

[22] Seymour, M. Gravity: VFX that's anything but down to Earth. https://www.fxguide.com/fxfeatured/gravity, Oct 2013. Online; accessed 25 Feb 2022.

[23] The Marmalade Visual Engineering. The Marmalade and Ronotics. https://www.youtube.com/watch?v=6pza9BlzFcw, Oct 2020. Online; accessed 5 Mar 2022.